WHAT IS CLAIMED IS:

1. A method of depositing a nanostructure-containing material onto a substrate, the method comprising:

(i) forming a suspension of pre-formed nanostructure-containing material in a liquid medium;

(ii) selectively adding a charger to the liquid medium;

(iii) immersing electrodes in the suspension, wherein at least one of the electrodes comprises the substrate; and

(iv) applying a direct or alternating current to the immersed electrodes thereby creating an electrical field between the electrodes;

whereby the nanostructure-containing material is caused to migrate toward, and attach to, the substrate.

2. The method of claim 1, wherein the nanostructure-containing material comprises at least one of nanotubes, nanowires and nanoparticles.

3. The method of claim 2, wherein the nanotubes comprising at least one of the following elements: carbon, boron, nitrogen, oxygen.

4. The method of claim 2, wherein the nanowires comprising at least one of the following: silicon, germanium, elemental metal, oxide, carbide, nitride, or chalcogenide.

5. The method of claim 2, wherein the nanoparticles comprise at least one of the following: elemental metal, elemental and compound semiconductor, oxide, or polymers.

6. The method of claim 1, wherein the nanostructure-containing material comprises at least one of single-walled and multi-walled carbon nanotubes.

7. The method of claim 1, wherein the nanostructure-containing material comprises single-walled carbon nanotubes.

8. The method of claim 3, wherein the single-walled carbon nanotubes are pre-formed by laser ablation, arc-discharge, or chemical vapor deposition.

9. The method of claim 1, wherein the pre-formed nanostructure-containing material comprises single-walled carbon nanotubes, and the method further comprises shortening the pre-formed single-walled carbon nanotubes by chemical reaction or mechanical processing prior to their introduction into the suspension.

10. 10. The method of claim 9, wherein the method further comprises annealing the pre-formed nanotubes at 100°C - 1200°C in a vacuum prior to their introduction into the suspension.

11. The method of claim 9, wherein the length of the carbon nanotubes is in the range of 0.1-100 micrometers.

12. The method of claim 1, wherein the liquid medium comprises at least one of water, alcohol, or dimethylformamide.

13. The method of claim 1, wherein step (i) further comprises either application of ultrasonic energy or stirring thereby facilitating the formation of a stable suspension

14. The method of claim 1, wherein the charger comprises at least one of magnesium chloride, $Mg(NO_3)_2$, $La(NO_3)_3$, $Y(NO_3)_3$, $AlCl_3$, and sodium hydroxide.

15. The method of claim 14, wherein the concentration of the charger is on the order of less than 1% by weight.

16. The method of claim 1, wherein the substrate comprises an electrically conductive material.

17. The method of claim 1 wherein the liquid medium comprises alcohol and the nanostructure-containing material single-walled carbon nanotubes, step (i) further comprises forming a suspension having a concentration of 0.1-1.0 mg/mL, expressed as mg of single-walled carbon nanotubes per ml of liquid medium.

18. The method of claim 1, wherein step (iv) comprises applying direct current to the electrodes.

19. The method of claim 18, wherein the electrical field applied between the two electrodes is in the range of 0.1- 1000V/cm and the direct current is in the range of 0.1 - 200mA/cm^2.

20. The method of claim 18, wherein step (iv) further comprises applying direct current to the electrodes for a time period of 1 second – 1 hour.

21. The method of claim 18, wherein step (iv) comprises creating an electrical field between the electrodes of at least 20V/cm in intensity.

22. The method of claim 1, further comprising the steps of:

(v) removing the electrodes from the suspension; and

(vi) annealing the coated substrate.

23. The method of claim 22, wherein step (vi) comprises a two-step anneal, comprising heating the coated substrate to a first temperature for a selected period of time, then heating the coated electrode to a second temperature for a selected period of time.

24. The method of claim 1, wherein step (i) further comprises adding additional materials into the suspension containing nanostructures.

25. The method of claim 24, wherein the additional materials comprise at least one binder material, wherein the binder is present in an amount ranging from 0.1-20 weight% of the nanostructure-containing materials.

26. The method of claim 25, wherein the binder is at least one of poly(vinyl butyral-co vinyl alcohol-co-vinyl acetate) and poly(vinylidene fluoride).

27. The method of claim 24, wherein the additional materials comprise small particles of at least one of: iron; titanium; lead; tin; or cobalt; and wherein the particles have a diameter less than 1 micrometer.

28. The method of claim 1, wherein step (iii) further comprises pre-coating at least one adhesion promoting layer onto the substrate prior to coating with the nanostructure-containing materials.

29. The method of claim 28, wherein the adhesion-promoting layer comprises at least one of: iron; titanium; cobalt; nickel; tantalum; tungsten; niobium; zirconium; vanadium; chromium; and hafnium.

30. A single-walled carbon nanotube film having a low threshold electrical field for electron emission, high emission current density, high total current output and long-term electron emission stability, the film formed by the method of claim 1.

31. The film of claim 30, wherein the threshold field is less than 1.5 volts per micrometer.

32. The film of claim 30, wherein the emission current density is larger than 1 A/cm^2.

33. The film of claim 30, wherein the total emission current is larger than 10mA for a $6mm^2$ area.

34. The film of claim 30, wherein the fluctuation of the emission current is less than 2% over 100 hours.

35. The film of claim 30, wherein the fluctuation of the emission current is less than 2% over 20 hours.

36. The film of claim 30, wherein the decay of the total emission current is less than 3% over 10 hours time at an initial current density of $100mA/cm^2$

37. The film of claim 30, wherein pulsed emission current can be generated by applying a pulse voltage to either of the electrodes.

38. The film of claim 37, wherein the pulse frequency of the emission current is higher than 10KHz.

39. The film of claim 37, wherein the pulse frequency of the emission current is higher than 100KHz.

40. The film of claim 37, wherein the pulsed current is higher than 10mA for a $6mm^2$ emission area and stable for up to 1,000 pulses.

41. The film of claim 37, wherein the pulsed current is higher than 10mA for a $6mm^2$ emission area and stable for up to 10,000 pulses.

42. A method of attaching a single nanotube, nanotube bundle or nanowire onto a sharp tip of a sharp object, the method comprising:

(i) forming a suspension of pre-formed nanostructure-containing material in a liquid medium;

(ii) selectively adding a charger to the liquid medium;

(iii) immersing at least one electrode in the suspension;

(iv) placing the sharp tip directly above the surface of the suspension and on a stage where the tip can be moved closer or further away from the surface of the suspension; and

(v) applying a direct or alternating current to the immersed electrode and the sharp object and electrically connecting a current meter to the sharp tip.

43. The method of claim 42, wherein the sharp object comprises a probe of an atomic force microscope or a scanning probe microscope and profilometer.

44. The method of claim 42, wherein steps (iv) and (v) further comprise moving the tip toward the surface of the suspension until electrical contact is established with the suspension, as indicated by the current meter, allowing the current to pass for a short period of time, and raising the tip above the surface of the suspension to break off electric contact.

45. The method of claim 44, comprising attaching an individual carbon nanotube, nanotube bundle or a nanowire to the sharp tip at the contact point of the sharp tip with the suspension.

46. The method of claim 45, further comprises annealing the tip after the nanotube, nanotube bundle, or nanowire is attached.

47. The method of claim 42, wherein step (iv) comprises placing an array of sharp tips on a substrate, and placing the substrate and the array above the surface of the suspension.

48. An object having a sharp tip coated with a single nanotube, nanotube bundle, or nanowire, the object comprising at least one of: a probe for an atomic force microscope or scanning probe microscope profilometer with improved spatial resolution and sensitivity, the object made according to the method of claim 42.

49. A method of depositing a nanostructure-containing multilayer structure onto a substrate, the method comprising:

(i) providing a multilayer structure comprising a substrate and a plurality of additional layers disposed on the substrate;

(ii) providing a plurality of exposed areas on a surface of the substrate;

(iii) forming a suspension of pre-formed nanostructure-containing material in a liquid medium;

(iv) selectively adding a charger to the liquid medium;

(v) immersing at least one electrode and the multilayer structure in the suspension;

(vi) applying a direct or alternating current to the electrode and the multilayer structure thereby creating an electrical field therebetween;

whereby the nanostructure-containing material is caused to migrate toward, and attach to, the exposed areas on the substrate.

50. The method of claim 49, wherein the substrate comprises a silicon material, and the additional layers comprise an oxide dielectric layer, a metal conductive layer, and a photoresist layer having a pattern of openings.

51. The method of claim 49, further comprising selectively etching the additional layers through the pattern of openings in the photoresist layer thereby forming the exposed areas on the surface of the substrate.

52. The method of claim 46, wherein the oxide dielectric layer is silicon dioxide.

53. The method of claim 50, wherein the oxide dielectric layer has a thickness in the range of 1 to 100 micrometers.

54. The method of claim 53, wherein the dielectric layer has a thickness of 1-10 micrometers.

55. The method of claim 49, wherein exposed areas define a pattern of evenly spaced holes or squares.

56. The method of claim 55, wherein the diameter of the hole or the side of the square is 1-100 micrometers.

57. The method of claim 49, wherein step (vi) comprises applying either a direct or an alternating voltage between the back surface of the Si surface and counter electrode.

58. The method of claim 50, further comprising applying a bias voltage between the Si substrate and the metal layer.

59. The method of claim 49, further comprising removing the photoresist layer after step (vi).

60. The method of claim 49, further comprises annealing the coated substrate at a temperature of 50-200°C.

61. The method of claim 49, further comprising annealing the coated substrate in vacuum at a temperature of 500-800°C.

62. A multilayer structure comprising a substrate having a surface with a plurality of areas coated with a nanostructure-containing material made by the method of claim 49.

63. The structure of claim 62, further comprising a plurality of additional layers disposed on the substrate.

64. The structure of claim 63, wherein the additional layers comprise an oxide dielectric layer, a metal conductive layer, and a photoresist layer.

65. The structure of claim 64, wherein the substrate is a silicon material.

66. A method of depositing a pattern of nanostructure-containing material onto a substrate, the method comprising:

(i) providing a substrate having a first surface with a mask disposed thereon, the mask having openings through which areas of the first surface are exposed;

(ii) forming a suspension of pre-formed nanostructure-containing material in a liquid medium;

(iii) selectively adding a charger to the liquid medium;

(iv) immersing at least one electrode and the masked substrate in the suspension;

(v) applying a direct or alternating current to the electrode and the masked substrate thereby creating an electrical field therebetween;

whereby the nanostructure-containing material is caused to migrate toward, and attach to, those exposed areas on the first surface of the substrate; and

(vi) removing the mask.

67. The method of claim 66, wherein the nanostructure-containing material comprises single-walled carbon nanotubes.

68. The method of claim 66, wherein the pre-formed nanostructure-containing material comprises single-walled carbon nanotubes, and the method further comprises shortening the pre-formed single-walled carbon nanotubes by chemical reaction or mechanical processing prior to their introduction into the suspension.

69. The method of claim 66, wherein the liquid medium comprises at least one of water, alcohol, or dimethylformamide.

70. The method of claim 66, wherein the electrical field applied between the two electrodes is in the range of 0.1- 1000V/cm and the direct current is in the range of 0.1 – 200mA/cm^2.

71. The method of claim 66, wherein step (i) comprises adding additional materials into the suspension, the additional materials comprise at least one binder material, wherein the binder is present in an amount ranging from 0.1-20 weight% of the nanostructure-containing materials.

72. The method of claim 71, wherein the binder is at least one of poly(vinyl butyral-co vinyl alcohol-co-vinyl acetate) and poly(vinylidene fluoride).

73. The method of claim 71, wherein the additional materials comprise small particles of at least one of: iron; titanium; lead; tin; or cobalt; and wherein the particles have a diameter less than 1 micrometer.